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A new estimation of the size of informal economy using monetary and full expenditures in a complete demand system

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Abstract

We use the demand system approach to estimate the size of informal economy in Turkey following the methodology based on the analysis of the individual consumption behaviour proposed by Pissarides, Weber (1989), Lyssiotou et al. (2004), and Fortin et al. (2009). We extend this method by taking into account both the monetary expenditures and time spent on domestic activities. The necessary information of money and time inputs in consumption on the household's level is obtained by statistical match of Turkish Family Budget and Time Use surveys (2006). As expected, the estimated model size of the informal economy in Turkey using the full (time plus money) expenditure is higher than those obtained by only monetary approach (in average 40.6% and 33.5% of GDP respectively) and also higher than obtained by more conventional macroeconomic methods (for example 35.1% by Schneider in 2005 with DYMIMIC model).

Classification-JEL or AMS : D01, D12, E26, C81
Keywords: informal economy, complete demand system, time use full expenditures

Résumé

Nous utilisons l'approche du système de demande basée sur l'analyse de comportement de consommation individuelle proposée par Pissarides, Weber (1989), Lyssiotou et al. (2004) et Fortin et al. (2009) afin d'estimer la taille de l'économie informelle en Turquie. Nous développons cette méthode en tenant compte à la fois des dépenses monétaires et temporelles consacrées aux activités domestiques des ménages. Les informations nécessaires sur les inputs monétaires et temporels dans les dépenses de consommation des ménages sont obtenues par la méthode d'appariement statistique des enquêtes turques sur le Budget des Familles avec l'enquête sur l'Emploi du Temps (2006). Comme attendu, la taille de l'économie informelle en Turquie estimée en utilisant les dépenses complètes (temps plus monnaie) est plus élevée que celle obtenues par l'approche monétaire (respectivement en moyenne 40,6% et 33,5% du PIB) et également plus élevée que celle obtenue par les méthodes macroéconomiques plus conventionnelles (par exemple 35,1% par Schneider en 2005 avec le modèle DYMIMIC).

Classification-JEL ou AMS : D01, D12, E26, C81
Mots-clés : économie informelle, système complet de demande, emploi du temps
dépenses complètes

Introduction

The common thought is that avoiding taxation and insufficiency of revenues are the main reasons of the underground economy[2]. As a vicious circle, undeclared economic activities of producers and households reduce the tax revenues, and an increase in taxes by public authorities to compensate for the loss in taxes, can reinforce the share of unreported incomes. Thus, identifying the nature of black economy and its mechanisms is essential for determining the best strategies for public authority. Therefore, the lack of reliable direct statistics on informal economy needs both the specific methodological solution and the appropriate data bases to obtain indirectly the evaluation of the size unreported incomes. The most frequently used methods are based on macroeconomic approach, giving very often disparate evaluations (cf. Schneider and Enste, *ibid.*). Nevertheless, very large differences between the obtained results due essentially to the used method prevent policy makers from evaluating the gravity of the problem and the choice of the appropriate policies. This is also the case of Turkey. Many methods used in the past such as *money demand* method by Ogunc and Yilmaz (2000), the *tax collections* method by Ilgın (2002), the *electricity usage* method by Us's (2004), *Multiple Indicators Multiple Causes Method* (MIMIC) by Schneider and Savaşan (2005) …etc. rises the discussion about the reliability of the estimated size of the informal sector and the used methods (see Ulgen and Ozturk (2006)). These studies give very different estimations of informal economy in Turkey from 3.61% (for Temel *et al.* (1994)) to 139% (for Akalin and Kesikoglu (2007)) according to the method used for relatively recent periods[3].

The theoretical background or various methods was frequently discussed and criticized. For instance, Thomas (1999) criticizes the macroeconomic models since they are not based on any theory. Thus, more recent but relatively rare studies using microeconomic approach based on households' budget surveys represent an interesting alternative. There are two main methods which use micro data for estimation of the size of black economy: first, the "direct" surveys asking directly respondents on their informal activities (Feinstein, 1999) and second the *expenditure-based* methods (Pissarides and Weber, 1989). The latter assumes that the classic family budget survey data can reveal income underreporting as excess food consumption. This approach was used for Turkey by Davutyan (2008) who estimated Turkey's informal sector by using household income and expenditure surveys within the Pissarides and Weber's methodology (food equation approach) and obtained the share of informal economy in GDP of 21% in 2005.

In our study we use the complete demand system approach developed by Lyssiotou et al., 2004 (and see also Fortin et al. 2009) [4], for the estimation of the size of black economy in Turkey. The model will be estimated on individual cross-section household data for the

[2] See Schneider and Enste,(2000).
[3] See appendix: Table A4
[4] According to Lyssiotou et al.,(2004) The black economy as % of GDP for UK calculated by complete demand system for 1993 is 10,6%. In Quebec it is between 4,6% - 5,7% during 1997-2002 respecting to the estimation of Fortin et al., (2009)

period 2003-2006. The model supposes that all wages are perfectly reported since the tax, which is linked to them is deducted automatically. Thus only self-employment income can be under-reported. It allows us to identify the coefficients of the under-reporting due to self-employment incomes by assuming that the consumption of each good, related to its marginal propensity of consumption, is the same as in the case of the revenue actually observed. Therefore, it is possible to compute the size of the underground economy on the basis of the information about the relative amount of the self-employment in GDP.

The contribution of this paper with respect to the previous approaches (Lyssiotou *et al 2004)*, Fortin *et al*. (2009) is twofold:

(i) We propose a new method to estimate under reporting part of household income on micro cross-sectional data within the complete demand system framework by using the full expenditures (money plus time) obtained by matching of the classic Family Budget and Time Use surveys. More precisely, we try to show in what way the time spent on domestic activity can change the size of informal economy[5].

(ii) We apply the model in the case of Turkey, a developing country while the previous applications contributions concerned only United Kingdom and Quebec. The high level of domestic production in developing countries[6] increases the possibility of substitution between formal and informal incomes via, among other, the domestic activity[7].

Section 1 presents the theoretical model of the complete demand system in the context of the under-reporting income from various sources. Section 2 gives the limits of adopted model. Section 3 derives the econometric specification of the model; section 4 introduces the combined Family Budget and Time Use surveys dataset used in estimations with short description of the matching procedure. Section 5 reports the empirical results and section 6 concludes focusing on the evaluation of the size of the informal economy in Turkey.

[5] According to Kasnakoglu and Dayioglu (2002), working tendencies can also be influenced by the domestic production and the effect of domestic activities on consumption-saving propensities become significant especially while we know that the easiness of reaching to quasi bank money like long run consumption loan possibilities raises quickly the goods and the service demand.

[6]The domestic production takes the important part in the daily life of Turkish households. According to Ilkkaracan and Gunduz (2009; p:18) this production can take the values between 25% and 45% of GDP at 2006 where the part of women changes between 79% or 86 %.

[7] In developing economies more than in developed countries the domestic activities may have an important role because of existing lower living standards and lower use of market services which may also influence the size of informal economy due to the motivation for compensating extra expenditures or even for minimizing certain monetary costs by help of this activity. In this respect, we try to show that how and in which way the time spent on domestic activity can amplify the size of informal economy

1. Theoretical Model

Consumer expenditure system

Following Lyssiotou et al.(2004) and Fortin et al. (2009), we consider that the households have separable preferences in durable and nondurable goods represented by a cost function[8]. This hypothesis allows us to have a Hicksian demand for all goods in which it is possible to represent household expenditure of any good as a share in the total expenditure on durable or nondurable goods.

Hicksian cost function can be written as C(**p**, U) = $F(c(\mathbf{p}, U), d(\mathbf{r}, U), U)$, where **p**, **r** and U correspond to the price vector of nondurable and durable goods, and to the household utility level. The $c(.)$ and $d(.)$ functions respectively represent the aggregate price indexes for nondurable and durable goods. In other words, they are the sub-cost functions which reflect the prices of unit costs paid by households for each type of good. Each of these functions increases in U and is linearly homogeneous in prices. Such structure implies that household consumption decision can be decomposed into *two-stage budgeting*.

(a) The household begins with allocating its total revenue Y* to the expenditure of durable and nondurable goods according to the cost minimizing rule (with the help of $c(.)$ and $d(.)$).

For example demand for the i^{th} good in the nondurable groups writes:

$$q_i = \frac{\partial F(.)}{\partial c}\frac{\partial c(.)}{\partial p_i} \tag{1}$$

So, we can aggregate the demand of q_i to household total expenditure of nondurable goods by using Shephard's lemma and the first degree homogeneity property on **p** of the $c(.)$ function.

$$y = \sum_i p_i q_i = \frac{\partial F(.)}{\partial c}\sum_i p_i \frac{\partial c(.)}{\partial p_i} = \frac{\partial F(.)}{\partial c}\partial c \tag{2}$$

(b) The second step, the household chooses the part of the expenditure about each good which belong to the given type of group (durable, nondurable) within the total expenditure of each group according to price vector of this group and to total utility level.

More precisely, the household initially determine the share of nondurable expenditures w_i within the total expenditures (y) in the nondurable goods as

$$w_i = \frac{p_i q_i}{y} = \frac{p_i \dfrac{\partial F(.)}{\partial c}\dfrac{\partial c(.)}{\partial p_i}}{\dfrac{\partial F(.)}{\partial c}c(.)} = \frac{p_i \dfrac{\partial c(.)}{\partial p_i}}{c(.)} = \frac{p_i}{\partial p_i}\frac{\partial c(.)}{c(.)} = \frac{\partial \ln c(.)}{\partial \ln p_i} \tag{3}$$

[8] See Deaton and Muellbauer, (1980)

Following Lewbel (1990) we suppose that $c(.)$ function has the Quadratic Logarithmic form

$$c(\mathrm{p},\mathrm{U}) = \exp\left[a(\mathrm{p}) + b(\mathrm{p})\left[\frac{\mathrm{U}}{1 - g(\mathrm{p})\mathrm{U}} \right] \right] \tag{4}$$

And with taking the logarithm of equation 4, we get

$$\ln c(\mathrm{p},\mathrm{U}) = a(\mathrm{p}) + b(\mathrm{p})\left[\frac{\mathrm{U}}{1 - g(\mathrm{p})\mathrm{U}} \right] \tag{5}$$

So, the function 3 can be written as the Hicksian shares

$$w_i = a_i(\mathrm{p}) + b_i(\mathrm{p})\left[\frac{\mathrm{U}}{1 - g(\mathrm{p})\mathrm{U}} \right] + \lambda_i(\mathrm{p})\left[\frac{\mathrm{U}}{1 - g(\mathrm{p})\mathrm{U}} \right]^2 \tag{6}$$

where $a_i(\mathbf{p}) = \partial \ln a(\mathbf{p}) / \partial \ln p_i$, $b_i(\mathbf{p}) = \partial \ln b(\mathbf{p}) / \partial \ln p_i$ and $\lambda_i(\mathbf{p}) = b(\mathbf{p})\, \partial \ln g(\mathbf{p}) / \partial \ln p_i$, and U represents the households utility level obtained from expenditure on nondurable and durable goods.

2. The limits of adopted model

We believe that the parameters under-reporting can suffer from the inconsistency between the income and the expenditure. More precisely, the hierarchy exists among all needs. The taxonomy of the needs determine the classification of the goods and the services such as durable or non durable and the necessity or luxury goods. According to the hypotheses of the model, the wages are mainly used for buying necessary goods and services, and the self-employment incomes are dedicated for buying durable luxury goods[9]. However, there may be some certain cases in which an inconsistency between the income and consumption may exist. More recently, Fortin (*ibid*; p.1268), show that the non-durable goods (like food) may also be considered as luxury good by households. This result contrariwise the firmly established postulates of the model, based on Engel curve, about the characterization of the behavior of the households in this model. Whether durable or not, non wage incomes can be allocated to all type of goods and services[10].

The negligence of durable goods in the estimated model may cause under estimation of the under reporting parameter. We believe that this under estimating of the black economy becomes more important while the share of durable goods can be as bigger as that of non durable goods. Turkey's situation, as a developing economy, may provide important insight for the comprehension of this phenomenon: Through the macro statistics about expenditures groups in "the household consumption expenditure rate statistics" from TURKSTAT[11],

[9] Lyssiotou, (2004), p:629 and Fortin et al. (2009),p:1263.
[10] Self-employment income tend to use their home as workplace, thereby spending more on necessities (food at home and fuel for heating) rather than potentially luxury goods like eating out, transport, clothing etc. see Lyssiotou, *ibid.*
[11] Turkish Statistical Institute (TUIK): http://www.tuik.gov.tr

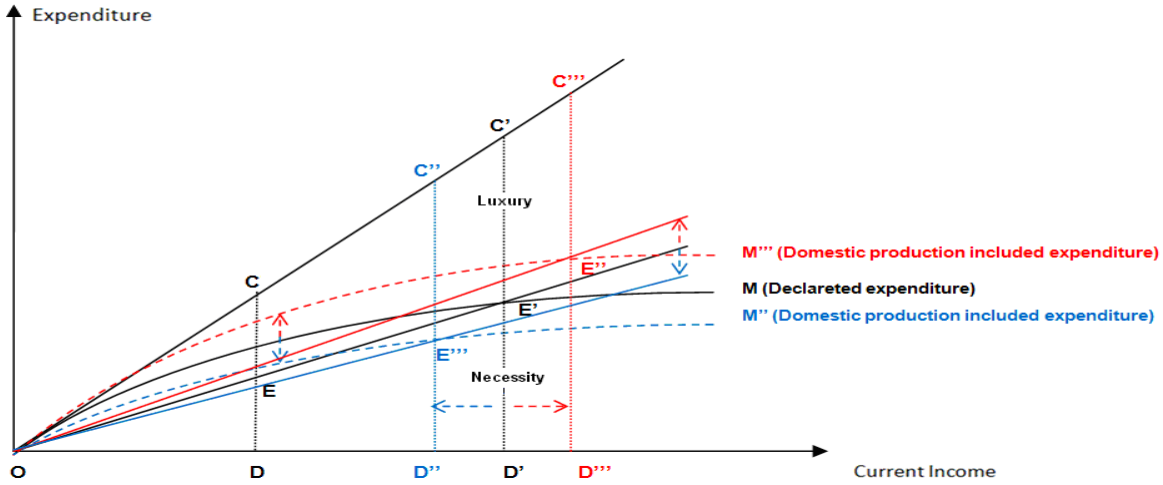
housing and rent expenditure share is 25,9 % while that of the food and non alcoholic is 24,9% in 2005. Housing and rent expenditures takes the biggest part in household's consumption in Turkey[12].

We propose *full expenditure* approach in order to overcome the under estimation problem for developing economies[13]. This approach is based on the household domestic production through the valuation of time spent in different activities (in a Beckerian framework). More in detail, time assignment theory, by Becker's (1965) pioneering work on time value, can make a contribution to better estimate the informal economy. Therefore, respecting to Becker's time allocation hypotheses, whether during working or not consumption always requires time and it is considered as a time not so different from other components of time in daily life. Therefore, households will always be assumed to combine non-working time and market goods to produce more basic commodities, called *domestic production*. In the spirit of Becker (*ibid.*p.495), domestic production, by the interaction between the non-working time and commodities, also require to consider services yielded by durable goods.

Engel Curve with domestic production

Ignoring domestic activity causes the bias in the estimation. Introducing the domestic production in to the complete demand system allows realizing more reliable measurement of black economy. From the theoretical point of view, we first assume that all households have identical preferences and current income which are allocated between two mains categories of goods as necessity and luxury according to the continuous Engel cure (OM) that we can follow from the graph 1[14].

Graph 1



[12] It seems that this not the case for European Union countries and for the France. Nutrition expenditure shares (including food and all beverages) are 26,79%, 28,76% and Dwelling(including housing, water, electricity, gas and other fuels) are 21,64% and 24,06% respectively for European Union (27 country) and France in 2005(source: eurostat, "nama_co3_c" statistics)

[13] For a detailed explanation of the use of full expenditure approach in the micro-econometric estimation see Gardes F., 2013

[14] In fact, according to Engel's original idea on the hierarchy of needs (see 1895, pp:8-9), their shares in the budget depend on the type of satisfaction but not on the type of goods. In other words, Engel is indifferent on types of goods.

The point E corresponds to the case of a household that reports income OD and has expenditure DE for necessity and CE for luxury. Respectively, the budget shares are DE/CD and CE/CD which are consistent with the higher level of income OD' where the income level must be raised from OD to OD' in accordance with the budget shares D'E'/C'D' and C'E'/C'D'. Therefore, the under reporting part of the income then determine by OD'/OD ratio. We can easily introduce the part of the consumptions realized by the domestic production in to the monetary expenditures of household. One may think at first that the consumption realized by the domestic production will decreases the need for additional income such as obtained from informal work. Such tendencies may also promote using the self-employment income to buy much more luxuries: The households may want to distribute their total income the way of reaching an optimal consumption level depending on their socioeconomic characteristics. Hence, the eventual income transmission one and another, via domestic activity, may influences the consumption expenses among the durable and non durable goods. This case is represented by two new dashed curves OM'' or OM''' in graph 1 implies that Engel curve may be over or under the initial OM Engel curve[15]. The crucial point is that the variation of expenditure will necessarily yield to consider a differentiation of income from the OD and OD'. Such relation can be followed respectively by O'''D''' or O''D'' at the following graphic where under reporting part of the income then be determined by OD'''/OD or OD''/OD ratio if and only if the domestic production is not zero.

3. Econometric model

The Hicksian share function considers household income as a good proxy for overall household utility obtained from the expenditure on nondurable and durable goods. That can be criticized for neglecting uncertainty on household decisions. More precisely, this overall utility ignores saving which may have potential important measurements consequences on the under-reporting of income insofar as self-employment income tends to be more volatile and, therefore, is less spent and more saved than employment income[16]. Especially for the developing economies, some durable or nondurable expenditures may be constrained by highly limited credits possibilities, which may imply measurement errors for these expenditures.

To avoid such problems this theoretical model is modified by following steps.

First, it is possible to substitute the utility U with households' true income Y* which gives rise to the Marshallian indirect utility function V = V (**p**, **r**, Y*). In order to calculate the budget share within the system of Engel Curves, we assume that the base period prices are **p** = **r** = 1 by introducing the *h* subscript which denotes the individual households[17] :

$$w_{ih} = \alpha_i + \beta_i \left[\ln Y_h^* \right] + \delta_i \left[\ln Y_h^* \right]^2 \qquad (7)$$

[15] Note that the place of this curve will be different for each household. If the concerning monetary expenditure doesn't exist for any household, the domestic production included expenditure will be the same for reported expenditure.
[16] Lyssiotou *et al.ibid* p.626
[17] *Ibid.*

where α, β, δ are the parameters. This equation represents the quadratic Engel curve expressed by the expenditure part of the durable and nondurable goods in the total expenditures, as the log of total revenue.

We assume in our model that Y* is separated into three sources as a, s, r which respectively correspond to other income sources, wages, independent revenues. Thus, the total reported (true) income is a proportion of these three sources.

$$Y_h^* = \sum_{m=a,s,r} \theta_m Y_{mh} \qquad (8)$$

This equation implies that the true income must be equal to the sum of the each observed income (Y_a, Y_s, Y_r) which are multiplied by their corresponding factor (θ_a, θ_s, θ_r), where we suppose $\theta_m \geq 1$. This condition implies that when the other incomes and wages are correctly reported, we have $\theta_a = \theta_s = 1$. In this case, it will be more convenient to expect that $\theta_r \geq 1$ within all durable and nondurable goods. Such hypothesis allows us to estimate the under reporting part of self employers under the assumption that self-employers may also save certain part of their under-reporting income to finance the durable and non-durable goods purchases. With regards to the Engel curve, the over reporting indicates the saving part of reported income. It allows us to calculate the size of the underground economy and the saving tendencies with respect to the under-reporting part of declared incomes by an estimation of θ_r.

In order to impose the constraints on θ_r parameter ($\theta_r \geq 1$), it can be expressed by (exp (k)+1) where k is the parameter estimated by the model[18]. In order to take into account the evolution of the underground economy between 2003 and 2006, this parameter interacts with a trend. The parameter becomes a function of time: k x *t* where *t* corresponds to the trend from 2003 to 2006[19]. The true value of independent revenue (Y_r*) can be then denoted as (exp (k)+1) *Y_r.

Finally, we can also determine the sum of each source of income as a ratio in comparison with reported total income: $y_m = Y_m/Y$. Where Y is the sum of other sources as fees, government transfers…etc. as well as wages and independent revenues[20]. Then, we can finally rewrite the estimation function (7) using the equations (8) as follows:

$$w_{ih} = \alpha_i + \sum_j \alpha_{ij} Z_{jh} + \sum_{n=1}^{3} \lambda_{in} (y_r)^n + \beta_i \left[\ln Y_h + \ln\left(\sum_{m=a,s,r} \theta_m y_m \right) \right] + \delta_i \left[\ln Y_h + \ln\left(\sum_{m=a,s,r} \theta_m y_m \right) \right]^2 + e_{ih} \qquad (9)$$

[18] See Fortin *et. al.*,(2009)

[19] Log $(\theta_r - 1) = k_0 + k_1 t + e_t$; t=2002,…,2006. Here $\theta_r - 1$ has an exponential trend: $\theta_r - 1 = \exp(k_0 + k_1 t + e_t)$. Therefore, for small changes $\Delta(\theta_r - 1)_t = (\theta_r - 1)_t - (\theta_r - 1)_{t-1}$ is approximately the proportionate change in $\theta_r - 1$: $\Delta \log(\theta_r - 1)_t \approx ((\theta_r - 1)_t - (\theta_r - 1)_{t-1}) / (\theta_r - 1)_{t-1}$ .Here, the right side this equation is the growth rate in $\theta_r - 1$ from period t-1 to period t. To turn the growth rate into a percent, we simply multiply by 100. If $(\theta_r - 1)_t$ follows then, taking changes and setting $\Delta e_t = 0$, then $\Delta \log(\theta_r - 1)_t = k_1$, for all years(t)

[20] See food note 10

Z represents the household characteristics vector in the model, which allows us to take into account the heterogeneity of the preferences. On the other hand, we cannot expect that the individuals who have independent revenues do not have the same reaction about their consumption and saving choices when their revenues vary. So, it is also possible to admit that the decision of the individuals cannot be the same for each income when there is uncertainty about these revenues. In accordance with Lyssiotou *et al.* (2004) and Fortin *et al.* (2009), we also introduce $(\sum^{3}_{n=1} \lambda_{in}(y_r)^n)$ in each equation in order to reflect the relative importance of independent revenues within the total household's income. The purpose of this expression is to diminish a possible confusion between consumption heterogeneity and the phenomena of under-reported part of independent income.

4. Micro data and matching

We use two primary household surveys Time Use Survey (TUS) and Household Budget Surveys (HBS) from the Turkish Statistical Institute (TURKSTAT).

The Household Budget Surveys have been conducted on a total of monthly 2160 and annually 25 920 sample households in 2003 and on a total of monthly 720 and annually 8 640 sample households in 2004, 2005 and 2006. Three basic groups of variables have been obtained from these surveys:

1. Variables of the socio-economic status of the households (type of housing, status of property, heating system, housing facilities, premises and transportation vehicles, etc.)

2. Variables related to individuals (age, gender, academic background), variables of employment status (occupation, economic activity, performance at work) income both available and unavailable for the activity in the last year. One of the most interesting part of HBS data is that the collection of income data is separated into 72 different variables[21]

3. Consumption expenditures variables (food-non alcoholic beverages, alcoholic beverages with cigarette and tobacco, clothing, health, transportation, education services, etc.)

In the Time Use Survey in 2006, approximately 390 households were selected each month giving a total of 5070 households during the whole year. Within these households 11 815 members aged 15 years and over were interviewed and were asked to complete two diaries – one for a weekday and one for a weekend day – by recording all of their daily activities during 24 hours at ten-minute-slots. This survey on Time use in 2006 is matching independently on the four Family budget surveys realizing a repeated cross-section of monetary and time expenditure data.

[21] We obtain more homogeneous sample also by we eliminate negative reported income data. Likewise, our advantage is that we don't need to eliminate the households whose independent or wage parts might be bigger than the unitary income (see Fortin , p.1265)

Matching Method

We combine the monetary and time expenditures in to unique good and service consumption activities at the individual level. We proceed with the matching of these surveys by regression on similar characteristics in both datasets as age, matrimonial situation, possession of cell phone, home ownership, number of household members, geographical location separately both for head of household and wife[22].

More precisely, we regress our key socioeconomic variables on 8 types of time use at TUS which are also compatible with the available data from FES as follows:

- Food Time (TUS) - Food Expenditures (HBS)
- Personal Care and Health Time (TUS) - Personal Care and Health Expenditures (HBS)
- Housing Time (TUS) - Dwelling Expenditures (HBS)
- Clothing Time (TUS) – Clothing Expenditures (HBS)
- Education Time (TUS) - Education Expenditures (HBS)
- Transport Time (TUS) - Transport Expenditures (HBS)
- Leisure Time (TUS) - Leisure Expenditures (HBS)
- Other Time (TUS) - Other Expenditures (HBS)

Food Time includes household and family care as administration of food[23]. Personal Care Time consists of personal care, commercial-managerial-personal services, helping sick or old household person. Housing Time corresponds to household-family care as home care, gardening-pet animal care, replacement of house-constructional work-repairing and administration of household. Clothing Time consists of washing clothes and ironing. Education Time includes study (education) and childcare. Transport Time consists of travel and unspecified time use. Leisure Time corresponds to voluntary work and meetings, social life and entertainment as social life, entertainment-culture, and resting-holiday, sport activity as physical practice, hunting, fishing etc., sport, hobbies and games as art, hobbies and games, mass media as reading, TV/Video, radio and music. Other Time includes employment and work searching times.

Valuation of time:

We use two methods for the valuation of time spent on domestic activities.

In the first method, we impute the wages net of taxes for the non-working individuals by a two step Heckman procedure by supposing that the time use is perfectly exchangeable

[22] The selection equation concerns the households which have a positive time use of their activities
[23] The food time consists only of cooking. The reason is that it is not possible to separate eating activity from Personal Care time use data.

between non market and market activities. Thus, the opportunity cost of non-market work is estimated as the expected hourly wage rate on the labor market for not working man and woman.

In the second method we simply use the official minimum wage rate for Turkey in 2006[24].

5. Empirical Results

We estimate a complete demand expenditure system (equation 9) using Generalized Method of Moments (GMM) for both – full expenditure (time plus money) and for only monetary expenditure. In the model, income variables are supposed endogenous. After several experiments, so as to select the appropriate instruments, we choose the following variables: age of husband and wife, matrimonial situation, number of children and having children higher than 16 years old, having open-ended contract both for husband and wife, daily working occupation both for husband and wife, husbands education level with the durable goods as television, cable TV, internet, refrigerator, deep freezer, dish machine, oven, cell phones in the vector of household characteristics [25].

The control variables included in the model are: the number of households members, the number of rooms in the house, the home ownership, the number of children under 16, geographic environment (urban or rural), husband in blue collar occupation, husband in white collar occupation, wife in blue collar occupation, wife in white collar occupation, wife worker at the company (under 10 workers)[26], husband wage worker, husband without working contract, wife wage worker, wife without working contract, and the durables goods dummies as computer owing, car owing, having a good heating system.

The estimation of the model (9) for full expenditure and exclusively monetary expenditure from the pooled cross-sectional data covering the period of investigation 2003-2006, is presented respectively in Table 2 and Table A2 in appendix[27]. Following this operation, the number of households selected passes 34 414 households. Only the parameters estimates of seven budget share equations are reported in these tables since the parameters of the eighth equation (other goods/services) are redundant due to adding up.

We obtain the size of informal economy for each year (Table 1) by scaling up under-reporting parameter k (estimated by monetary and full expenditure) with the income part of self employers in GDP (Table A3 in appendix). The corresponding size of informal economy reduce from 33.99% to 28,9% and from 41,22% to 35,1% of GDP between 2003 and 2006 respectively for the monetary and the full expenditure estimation.

[24] Note also that the opportunity cost may rather be below this value. For the details, see Gardes (2013)p: 4
[25] See also Lyssiotou *et al.* (2004), p:632
[26] After several essays, for having more accurate result in underreporting parameter this variable is ignored in full expenditure estimation
[27] Based on 2003 year variables, over identifying restriction in the estimation is 25,84 with degree of freedom equal to 25. Chi-square p value for monetary estimations is 0.41 which is bigger that 0,05 where null hypotheses and the validity of the identifying instruments cannot be rejected for the chosen control variables. We keep the same control variables and don't add new ones so as to compare the results obtained from both estimation.

Table 1

Year	2003	2004	2005	2006
Size of black economy for monetary estimation	33,99%	35,98%	35,00%	28,90%
Size of black economy for full expenditure estimation	41,22%	43,64%	42,50%	35,10%

Taking into account the value of domestic activity leads to a significant increase in informal economy size. The corresponding size of informal economy over the considered period is systematically higher for full expenditure than for monetary one, up to 7, 77 percentage points in 2004. Therefore, the size of black economy in 2004 is 2, 42% and 1, 14 % higher respectively from that of 2003 and 2005. However, the size is informal economy for full and monetary expenditure in 2006 is 7,4% and 6,1 % lower from 2005. The difference between full expenditure than for monetary one is 6, 20% in 2006. The observed variability of this size in 2006 mainly is due to changes in the income part of independent workers (as % GDP) in 2006. The income part of independent workers (as % GDP) is decreased by 14, 42 % in 2006 as much as in 2005.

Nevertheless it would certainly need an economic explanation on the reason of continuous decreases in the size of informal economy after 2004 linked very probably to the economic situation in the country. Through the macro statistics from TURKSTAT[28], the differences between these years may be due to both decreases in inflation rate and increases in disposable incomes in 2004. Consumer Price Index (CPI) for the year 9,3% and 7,7% respectively in 2004 and 2005 while it was 29,7% and 18,4% respectively in 2002 and 2003. According to the total employment and annual average disposable income from employment of household members by employment status statistics from TURKSTAT, the self employment disposable income raised by 22,5% in 2004 with respect to the 2003 and it continues in following years[29]. Moreover, labour force participation rate and employment rate increases from 2004 on while there was a decrease in underemployment between 2004 and 2006[30]. These exceptional economic evolutions may explain the reasons of the gradual decrease of our estimated size of informal economy especially for full (time plus money) expenditure after 2004 until 2006.

Only the monetary result of the size of the informal economy is the same as the results by other authors while the full expenditure result is apparently higher that these estimations. Specifically, when compared with Schneider and Savaşan (2007) estimations with DYMIMIC model (Table A4) they show the significant similarity with monetary estimation. Therefore, our monetary expenditure estimation gives the size of informal economy in 2005 as large as 35% of GDP which is 14 percent points bigger than the microeconomic estimates of Davutyan (2008) (21%, see Table A4). The difference is that Davutyan (2008) used the single equation model with only the food expenditures. We consider all goods and services in our model within the complete demand estimation framework which gives more reliable results of all parameters and especially those of income under-reporting.

[28] Turkish Statistical Institute (TURKSTAT): http://www.tuik.gov.tr
[29] Thereby, this growth was 5,94 % in 2005 when compared with 2004
[30] Underemployment rate(%) between 2004-2006 are 10,8%, 10,6%, 10,2%, respectively

Table 2

2003-2006 Full Expenditure Empirical Results Based on the Complete Demand System All Population (GMM)

Variables	FOOD	t- ratio	PC+HEALTH	t- ratio	HOUSING	t- ratio	CLOTHING	t- ratio	EDUCATION	t- ratio	TRANSPORT	t- ratio	LEISURE	t- ratio
Constant	0.09527	15.63	0.19646	55.08	0.00239	0.34	-0.01038	-2.51	-0.00984	-2.17	0.04205	5.50	0.47874	83.69
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	0.07254	24.88	-0.01222	-6.84	0.01111	3.13	-0.01674	-8.67	-0.01156	-6.38	-0.01779	-5.78	-0.01667	-5.65
2005	0.08083	55.45	-0.03445	-43.55	0.07465	49.09	0.01496	19.78	0.00135	2.53	0.00733	6.37	-0.10792	-103.72
2006	0.10188	64.14	-0.04772	-57.32	0.12028	71.93	0.02228	28.81	0.00857	15.50	0.01215	9.95	-0.15293	-128.63
Number of households members	0.00749	30.92	-0.00119	-10.32	-0.00592	-26.74	0.00150	12.90	0.00042	6.88	-0.00061	-4.23	-0.00278	-16.99
Home ownership	0.00622	9.08	-0.00333	-6.82	0.00019	0.22	0.00076	1.65	0.00097	2.59	-0.00162	-2.19	0.00029	0.46
Husband in white collar occupation	-0.00062	-0.65	-0.00282	-4.38	-0.00457	-3.62	0.00395	5.88	0.00070	1.31	-0.00202	-1.80	0.00347	3.76
Husband in blue collar occupation	0.00200	2.45	-0.00097	-1.78	0.00105	1.03	0.00106	2.02	0.00035	0.97	-0.00505	-6.49	-0.00185	-2.58
Wife in blue collar occupation	-0.00631	-3.28	-0.00216	-1.43	0.00406	1.67	0.00111	0.85	0.00207	1.73	0.00294	1.22	-0.0054	-3.13
Wife in white collar occupation	0.00357	1.36	-0.00705	-3.22	0.00266	0.73	0.00479	2.29	0.00111	0.64	0.00339	0.82	-0.00283	-1.11
Husband with out contract	0.00510	1.95	-0.00531	-3.68	0.00616	2.12	0.00675	4.76	0.00217	2.29	-0.00000	-0.00	-0.01352	-5.73
Husband wage worker	-0.0074	-8.59	0.00481	7.21	0.01380	7.40	0.00729	8.78	0.00222	4.41	0.01158	11.54	-0.02255	-11.34
Wife with out contract	-0.00988	-3.57	0.00299	1.40	0.00145	0.39	-0.0018	-0.97	0.00198	1.17	0.00265	0.85	0.00173	0.66
Wife wage worker	-0.00552	-2.51	0.00862	4.96	0.00441	1.52	0.00222	1.38	0.00014	0.10	0.00454	1.61	-0.01334	-6.73
Area (urban = 1)	-0.02918	-28.39	0.00539	9.71	0.02932	24.58	-0.00325	-5.92	0.00189	5.09	-0.00411	-4.95	0.00227	2.76
Computer	-0.01472	-14.64	-0.00234	-3.06	-0.00375	-2.61	0.00251	3.22	0.00872	10.94	0.00955	5.95	0.00605	5.72
Car	-0.00724	-9.50	-0.00947	-18.37	-0.00903	-9.15	0.00063	1.24	0.00089	2.38	0.04654	44.89	-0.0142	-20.50
Good heating system	-0.00998	-10.39	-0.00711	-10.81	0.03429	26.53	0.00046	0.68	0.00342	5.73	0.00016	0.14	-0.01037	-12.02
Number of rooms in the house	-0.0021	-4.19	-0.0021	-7.59	0.00961	17.43	0.00120	4.26	0.00060	2.95	-0.0004	-0.94	-0.00412	-10.97
Children under than 16 years old	0.00440	5.82	-0.00385	-7.84	0.00481	5.22	0.00243	5.06	0.00060	1.57	-0.00105	-1.40	-0.00658	-9.72
Y	0.00403	3.35	-0.00235	-3.28	0.01326	9.08	0.00135	1.50	0.00069	0.65	0.00511	2.92	-0.0169	-14.57
Y^2	-0.00025	-4.36	-0.00000	-0.11	-0.00023	-3.12	0.00016	3.38	0.00006	1.05	-0.00013	-1.39	0.00031	5.58
yr	0.00003	8.53	0.00004	10.17	-0.00000	-0.53	-0.00000	-3.98	-0.00000	-2.35	0.00001	4.49	0.00011	10.15
yr^2	0.00000	3.85	0.00000	4.22	-0.00000	-0.62	-0.00000	-2.42	-0.00000	-1.59	0.00000	3.70	0.00000	4.17
yr^3	0.00000	2.57	0.00000	2.68	-0.00000	-0.76	-0.00000	-2.21	-0.00000	-2.01	0.00000	3.03	0.00000	2.66

Under-reporting Self-employment (Yr)	Parameter	t ratio
k (under reporting ratio for yr)	**1.64**	**4.22**

6. Conclusion

We use a new method to estimate under reporting part of household income on micro cross-sectional data within the complete demand expenditure system (equation 9) via a Generalized Method of Moments (GMM) by using the full expenditures (money plus time) obtained by matching of the classic Family Budget and Time Use surveys. We apply the model in the case of Turkey, for a developing country, first time, while the previous applications contributions concerned only United Kingdom and Quebec. In doing so, we show the importance of domestic activities in our estimation of the size of informal economy for Turkey as a developing economy.

The model is well estimated with almost all parameter estimates significant. More in detail, we consider all goods taking into account the domestic production in a complete demand system framework by adding the valuated time use of various activities to the corresponding monetary expenditure increases significantly the estimation of the size of informal economy in Turkey: in average 40.6% and 33.5% of GDP respectively for full expenditure and monetary ones over the 2003-2006 periods. Comparing our results for developing country Turkey with Quebec (Fortin et al. 2009) based on the same methodology shows a very large difference about 6% for Quebec in 2002 and about 33,9% for Turkey in 2003 (in comparable monetary only approach).

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APPENDIX

Table A1: Descriptive Statistics

Budget Shares	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
MONETARY EXPENDITURES	Food	34414	0.3139	0.1528	0	1.0000
	Personal Care(with Health)	34414	0.0782	0.0756	0	0.8362
	Housing	34414	0.3336	0.1398	0	1.0000
	Clothing	34414	0.0586	0.0703	0	0.5893
	Education	34414	0.0117	0.0465	0	0.8323
	Transport	34414	0.0799	0.0982	0	0.8723
	Leisure	34414	0.0586	0.0570	0	0.8859
Budget Shares	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
FULL EXPENDITURES	Food	34414	0.1600	0.0744	0.0154	0.7459
	Personal Care(with Health)	34414	0.1441	0.0427	0.0071	0.6846
	Housing	34414	0.1716	0.0896	0.0261	0.9040
	Clothing	34414	0.0327	0.0375	0.0004	0.4431
	Education	34414	0.0097	0.0282	0.0001	0.7469
	Transport	34414	0.0825	0.0619	0.0070	0.7838
	Leisure	34414	0.2678	0.0796	0.0177	0.8674
Household income share :	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
	Self employment / Total Income	34414	61.7010	387.1789	0	20000.00
	Wage / Total Income	34414	71.4754	261.7365	0	7380.00
	Other income / Total Income*	34414	106.7364	349.9777	0	12000.00
	ln(Total Income)	34414	6.6002	0.8720	0.0800	11.0532
Demographic characteristics:	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
	No. of children	34414	1.4072	1.4372	0	13
	Children smaller then age of 16	34414	0.6440	0.4788	0	1
	Number of households members	34414	4.3325	1.9661	1	23
Occupation dummies:	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
	Husband in white collar occupation	34414	0.2075	0.4055	0	1
	Husband in blue collar occupation	34414	0.3681	0.4823	0	1
	Husband in other types of occupation	34414	0.4241	0.4942	0	1
	Husband with out contract	34414	0.0314	0.1745	0	1
	Husband worker at the company (under 10 worker)	34414	0.5379	0.4985	0	1
	Husband wage worker	34414	0.5210	0.4995	0	1
	Husband formal worker	34414	0.5290	0.4991	0	1
	Wife in white collar occupation	34414	0.0298	0.1700	0	1
	Wife in blue collar occupation	34414	0.0505	0.2191	0	1
	Wife in other types of occupation	34273	0.9233	0.2659	0	1
	Wife with out contract	34414	0.0156	0.1242	0	1
	Wife worker at the company (under 10 worker)	34414	0.2061	0.4045	0	1
	Wife wage worker	34414	0.0550	0.2279	0	1
	Wife formal worker	34414	0.0522	0.2224	0	1
Regional location dummies:	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
	Area (urban = 1)_Dummy	34414	0.6651	0.4719	0	1
Durables and luxury goods :	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
	Car	34414	0.2622	0.4398	0	1
	Television	34414	0.9775	0.1481	0	1
	Good heating system (includes central heating)	34414	0.1754	0.3803	0	1
	Cabel TV	34414	0.0373	0.1895	0	1
	Computer	34414	0.1213	0.3265	0	1
	Internet	34414	0.0426	0.2020	0	1
	Refrigerator	34414	0.9797	0.1409	0	1
	Deep freezer	34414	0.0411	0.1986	0	1
	Dish machine	34414	0.2219	0.4155	0	1
	Oven	34414	0.0496	0.2171	0	1
	Clima	34414	0.0385	0.1924	0	1
	Cell phones	34414	0.6761	0.4679	0	1
Housing:	**Variable**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
	Home ownership	34414	0.6673	0.4711	0	1
	Owing house-resting debt	34414	0.0271	0.1624	0	1

Table A2

2003-2006 Monetary Expenditure Empirical Results Based on the Complete Demand System All Population (GMM)

Variables	FOOD	t- ratio	PC+HEALTH	t- ratio	HOUSING	t- ratio	CLOTHING	t- ratio	EDUCATION	t- ratio	TRANSPORT	t- ratio	LEISURE	t- ratio
Constant	0.53949	46.61	0.04128	6.34	0.38695	32.66	-0.00448	-0.63	-0.03586	-6.48	-0.0073	-0.68	0.01610	2.59
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	0.11149	19.89	-0.03384	-11.15	0.04800	8.96	-0.03307	-11.22	-0.01735	-8.13	-0.0358	-9.01	-0.02419	-9.87
2005	0.00423	1.62	-0.00342	-2.38	-0.01261	-5.01	0.00002	0.02	-0.00016	-0.20	0.00998	5.95	0.00165	1.70
2006	-0.01989	-7.95	-0.00198	-1.44	-0.00195	-0.80	-0.00043	-0.34	0.00355	4.39	0.01531	9.16	0.00305	3.21
Number of households members	0.01589	33.92	-0.00169	-7.41	-0.01664	-40.97	0.00251	10.61	0.00066	6.26	-0.00122	-5.24	-0.00129	-8.15
Home ownership	0.01900	13.29	-0.0084	-8.88	-0.00021	-0.13	0.00321	3.65	0.00270	4.25	-0.00321	-2.87	-0.0033	-4.49
Husband in white collar occupation	-0.00028	-0.14	-0.0093	-7.48	0.00094	0.42	0.00633	5.05	0.00147	1.59	-0.00715	-4.20	0.00737	7.42
Husband in blue collar occupation	-0.00248	-1.43	-0.00029	-0.26	0.00659	3.58	0.00017	0.17	0.00023	0.36	-0.01056	-8.55	0.00065	0.82
Wife in blue collar occupation	-0.03276	-7.73	0.00155	0.51	0.01121	2.46	0.00249	0.97	0.00377	1.78	0.00605	1.69	0.00081	0.38
Wife in white collar occupation	-0.00505	-0.98	-0.01155	-2.96	0.00343	0.56	0.00674	1.84	0.00290	1.03	-0.00005	-0.01	0.00736	2.53
Wife worker at the company (under 10 worker)	0.02806	11.32	-0.00152	-1.20	-0.02652	-11.56	-0.00273	-2.22	0.00075	1.06	-0.0002	-0.14	0.00000	0.00
Husband with out contract	-0.02857	-5.78	0.00564	2.18	-0.01987	-4.30	0.01515	6.27	0.00572	3.81	0.01278	5.09	0.00133	0.72
Husband wage worker	-0.07324	-33.11	0.03508	26.69	-0.02568	-11.13	0.01491	12.17	0.00746	9.01	0.03281	20.94	0.00993	10.27
Wife with out contract	-0.02657	-4.30	0.00432	1.07	0.00572	0.85	-0.00078	-0.22	0.00549	1.70	0.00552	1.15	0.00156	0.48
Wife wage worker	-0.02644	-5.94	0.02680	7.81	-0.02524	-5.02	0.00177	0.61	0.00017	0.08	0.01410	3.42	0.00254	1.09
Area (urban = 1)	-0.07211	-30.74	0.00847	7.31	0.06975	30.65	-0.00588	-5.23	0.00434	6.69	-0.0063	-4.55	0.00149	1.76
Computer	-0.02652	-14.49	-0.00092	-0.73	-0.02185	-9.43	0.00182	1.38	0.01351	10.93	0.01179	5.45	0.02348	19.31
Car	-0.03996	-25.43	-0.00863	-9.08	-0.03707	-21.37	-0.00122	-1.28	0.00184	2.83	0.08843	59.13	0.00056	0.74
Good heating system	-0.0314	-17.70	-0.00904	-7.69	0.04797	21.75	-0.00095	-0.80	0.00571	5.81	-0.00286	-1.68	0.00119	1.31
Number of rooms in the house	-0.01715	-16.58	-0.00077	-1.41	0.01381	13.72	0.00131	2.37	0.00119	3.66	-0.00033	-0.51	0.00292	7.14
Children under than 16 years old	0.00351	2.29	-0.00496	-5.30	0.00532	3.27	0.00408	4.55	-0.00039	-0.62	-0.00311	-2.75	-0.00134	-1.83
Y	-0.02119	-10.61	0.00541	4.81	-0.00678	-3.18	0.00465	3.33	0.00411	3.55	0.01020	4.65	0.00359	2.89
Y^2	0.00021	2.53	-0.00003	-0.57	-0.00007	-0.72	0.00004	0.72	-0.00006	-0.94	-0.00024	-2.17	0.00002	0.47
yr	0.00011	10.04	0.00000	3.99	0.00008	9.18	-0.00000	-1.79	-0.00000	-4.07	-0.00000	-0.09	0.00000	0.41
yr^2	0.00000	4.29	0.00000	2.82	0.00000	4.10	-0.00000	-1.57	-0.00000	-2.70	0.00000	0.55	0.00000	0.76
yr^3	0.00000	2.70	0.00000	2.37	0.00000	2.65	-0.00000	-1.59	-0.00000	-2.56	0.00000	0.38	0.00000	0.98

Under-reporting Self-employment (Yr)	Parameter	t ratio
k (under reporting ratio for yr)	**1.35**	**3.81**

Overidentifying Restrictions= 25.84 with chi-square P value =0.41> 0,05

Table A3

	2003	2004	2005	2006
The income part of self employers as % of GDP	25,09	26,56	25,88	21,37

Source: Turkish Statistical Institute (TURKSTAT)

Table A4

UNDERGROUND ECONOMY MEASUREMENTS IN TURKEY (1)

Author(s)	Period/Year	Method or Approach	(underground/registered GDP)
Hakioglu(1987) (1990)	1984 1989	(Currency demand)	137.80 18.00
Derdiyok(1993)	1984 1991	(Monetary approach) (Tax auditing approach)	27.30 46.94
Altug (1993)	1992	(Underground wage level method)	35.00
Ozsoylu (1993)	1990	(GNP approach) (Simple currency ratio method) (Transaction method)	7.5 11.50 11.50
Kasnakoglu(1993)	1968 - 1990 1963 - 1990	(Currency ratio) (Currency demande)	–4.22 – 34.85 0 – 22.55
Temel et al. (1994)	1987 - 1992 1984 - 1991 1970 - 1992 1970 - 1992 1975 - 1992	(Discrepancy method) (Tax auditing) (Currency ratio) (Transaction method) (Currency demand)	1.48 – 3.61 8.2 – 91.55 0 – 26.26 0 – 26.26 -6.34 – 20.29
Yayla (1995)	1968 - 1993 1968 - 1993 1968 - 1993	(Currency ratio) (Currency demande) (Transaction method)	–4.30 – 99.55 0 – 42.09 0 – 62.45
Us (2004)	1985 -2002 1978 - 2000 1987 - 2003 1987 - 2003	(Tax auditing) (Physical input approach) (Currency ratio) (Currency demande)	26 – 184 -1 – 33 0 – 90 3 – 12
Baldemir et al. (2007)	1980 - 2003	(MIMIC)	15.58 – 10.80
Akalin et Kesikoglu (2007)	1975 - 2005 1975 - 2005	(Mon. App. Basic rate theory) (Advenced rate theory)	7 – 46 17 – 139
Schneider et Savasan (2007)	1999 - 2005	(DYMIMIC)	31.1 – 35.1
Davutyan (2008)	2005	Single Equation	21